A Comparative Study of Cloud Services Use by Prospective IT Professionals in Five Countries

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Abstract

Individuals and organizations utilise the cloud technology and its services in various ways. Cloud-based services are becoming increasingly popular, while there is no adequate knowledge offered for their secure use in the education for future IT professionals. It is important to understand how security and privacy issues are perceived and handled by male/female users and IT professionals of different cultures. The authors aim at presenting and scrutinizing information about cloud services' use by prospective IT professionals in five countries, namely China, Finland, Greece, Nepal, and the UK. In particular the authors, wanting to find out what are the future IT professionals' conceptualisations and awareness, collected data from male and female IT students in higher education, who use (or not) cloud services. The authors further illustrate the research findings by proceeding to a comparative analysis considering different perspectives such as: gender, education background, national culture (values and culture), and IT-related knowledge. The final research outcomes reveal attention-grabbing information for future IT professionals' skills, knowledge, and digital competencies. For the IT professionals and software quality engineering communities the latter comprise a body of realistic knowledge, worthy of note when designing curricula for security technology by accommodating practical and accessible solutions (e.g., cryptography-based cloud security) for developing and enhancing the IT professionals' role.

Keywords: Cyber-security, Cloud-Based Services, Software Quality, IT Professionals' Role, National Culture, Gender Issues, Higher Education.

1 Introduction and Research Rationale

Cloud services [1, 2] are becoming popular day by day for different purposes such as data storage, application deployment, test and development, data backup and many other purposes which often include very sensitive, private data. Therefore, it is crucial for the cloud users and IT professionals [3] to understand how secure a cloud-based service is; and if it is not secure, what might be the associated security problems [4] and what could be the feasible solutions. For an IT professional, in order to propose any appropriate solution [3, 4], it is important to understand the broad and international usage of the cloud-based services and associated technology.

In this work the authors present the data collected about cloud services' use by prospective IT professionals in five countries, namely China, Finland, Greece, Nepal, and the UK. Thus, there is illustrated information on the use of cloud services but also the reasons for not using the cloud technology. The information presented here reveals the conceptualisations of a sample of future IT professionals of these five countries about use and security of the cloud applications.

It seems that there is a need to re-design the curricula in higher-levels of education in order to prepare the IT professionals to i) gain more security-related knowledge, ii) act professionally and ethically in the society, and iii) become more familiar with the international and broad cloud-based services. Additionally, cloud technology needs to be exposed so that cyber-security issues and security measures to overcome those issues are integrated into subject-taught knowledge. The research outcomes of this trans-national survey could also be useful for developing and wide-reaching the cloud security related knowledge and cyber-safety applications in every country, considering suitable solutions for different cultures (see [5, 6, 7, 8, 9]).

The paper is organised by first presenting the research rationale, questions and brief description of the research methodology, and then proceeds to data illustration, description and analysis' comments and observations as far as the current data sets permit. Last, there is a session of conclusive remarks, limitations and future research considerations.

2 Research Questions and Methodology

2.1 Research Questions

In this research study, the authors aim at answering the following questions that are first unfolded in this paper:

- How many prospective IT professionals use cloud services and which are their background profiles?
- What is the percentage of male and female users in every country?
- Which are the reasons of not using cloud-based services and which are the profiles of the citizens who do not use them?

2.2 Research Methodology

A questionnaire was designed in Finland with the participation of all the members of our international research team on cyber-security. To fulfil the designing

objective for conducting surveys in a multi-cultural and multi-national research environment, was as follows: The doctoral and post-doctoral researchers and research assistants from many countries organized several brainstorming online and offline (face to face) sessions to determine the most appropriate and complete set of questions, and suitable ways to present them [10], such as translating the questionnaire when in need. We had a pilot survey and published the results [9] and afterwards we translated and distributed the questionnaire in the five countries we consider herein. This research study is international and ongoing. We are currently collecting more data from the UK and Australia, while data from African countries and North and South America is being planned and expected to take place in the near future.

3 Data Collection and Data Analysis

For this study, we collected survey data through printed and distributed to fill in questionnaires from five countries, three from Europe and two from Asia, respectively: Finland, Greece, UK, China and Nepal. We collected data from higher-levels IT students, who are the future IT professionals in these countries' educational and socio-technical systems. Our current data set (data used herein) contains the largest numbers of data from Greece (three Universities) and Finland (three Universities) as shown in figure 1.

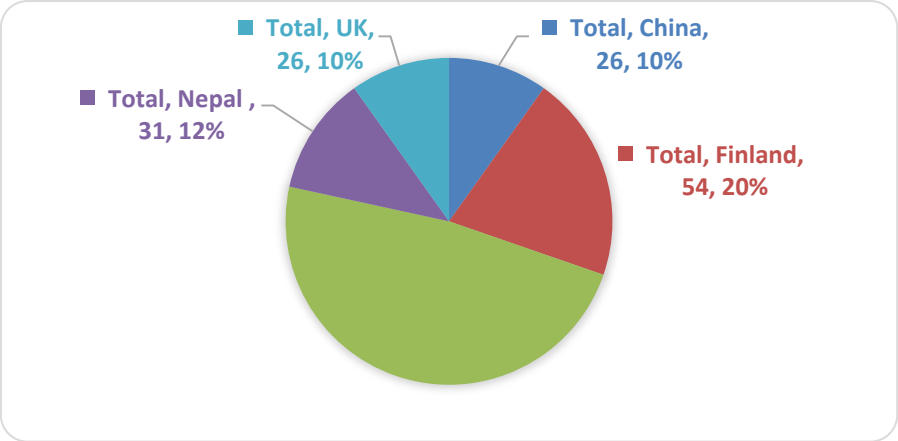

Figure 1: Categorization of data sets by country

The current dataset handled here contains 48% collected data from Greece. A further 20 % of the data come from Finland, which is the second largest country for the collected data. Nepal is the third country for the data collected contributing with 12% of the data, from one University. We have currently collected equal amount of data (10%) from China (one University) and UK (one Unversity) but more data is on its way from both countries.
The current percentages of male and female participants are shown in figure 2. The percentage of male participants is 71.59 % whereas 28.41% is the percentage of female participants.

The following figures illustrate the current findings and a brief text description and analysis in comparison.

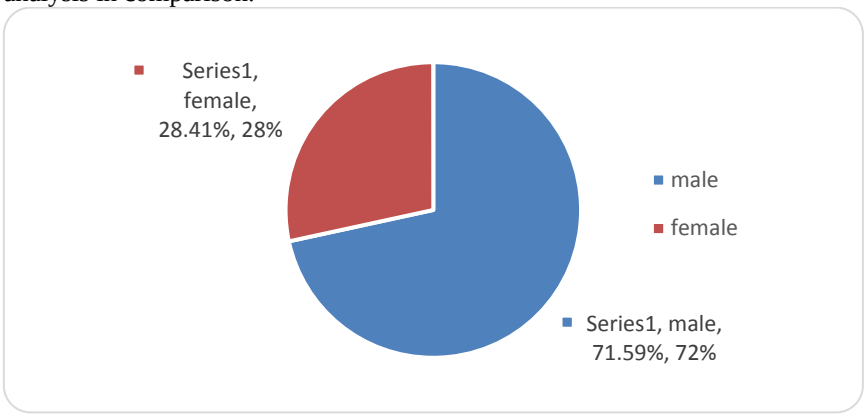

Figure 2: Total percentages of male/female participants in the current data sample

We categorized the male and female participants in all those five countries as shown in figure 3. As shown in figure 2, China has the largest percentage of male and the least percentage of female participants with 84.62 % of male participants and 15.38 % of female participants. Similarly, Nepal has the second largest percentage of male participants (83.87%) and the second least percentage of female participants (16.12 %). UK has 76.92% of male participants and 23.07 % of female participants whereas Greece has 66.93% of male participants and 33.07% of female participants. Last, Finland has the least percentage of male participants (66.67%) but the largest percentage of female participants (33.33 %).

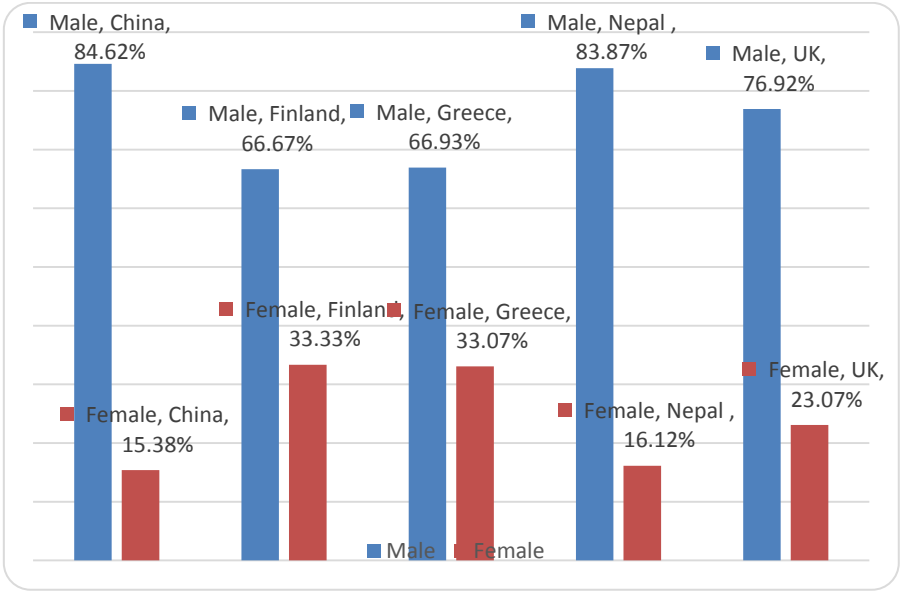

Figure 3: Categorization of data (Male and Female) per country

We collected data from 26 participants from China, out of which 22 participants were male and 4 were female as shown in figure 4, next. As shown in figure 5, among the male participants only 68.18 % (15 in number) use cloud whereas 31.82% (7 in number) do not use cloud. Similarly, only 25 % (1 in number) of female participants use cloud while the rest of 75% (4 in number) do not use cloud.

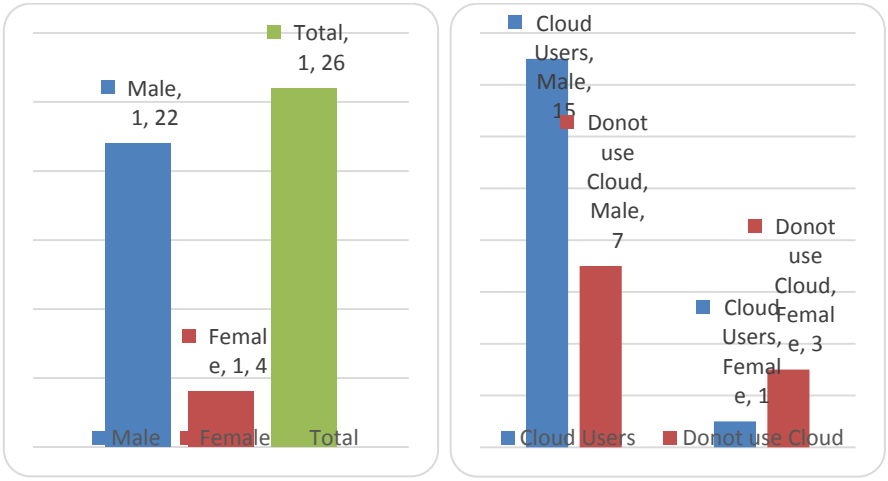

Figure 4 & Figure 5: Categorization of data collected in China

In Finland, we collected data from 54 participants consisting of 36 males and 18 females as shown in figure 6, next. Among the male participants, only 91.67% (33 in number) of them use cloud and 8.33% (3 in number) do not use cloud while all the female participants use cloud as shown in figure 7.

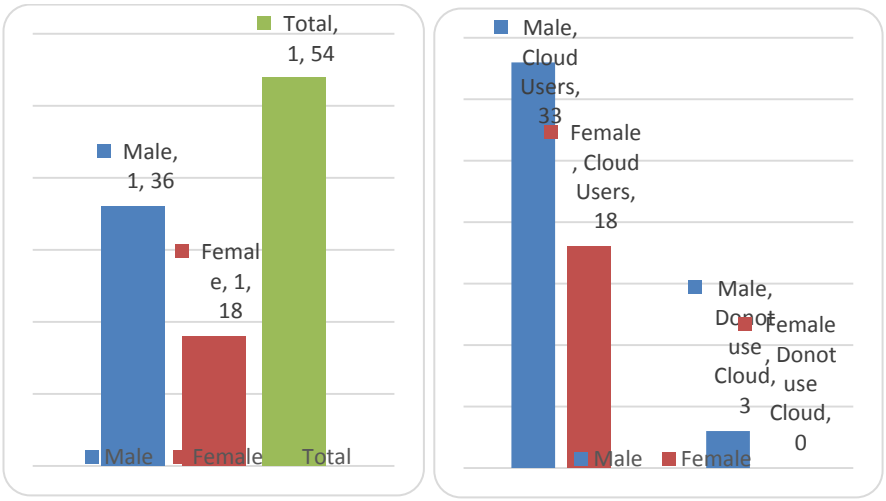

Figure 6 & Figure 7: Categorization of data collected in Finland

We collected data from 127 participants in Greece and the data set contains 85 male participants and 42 female participants as shown in figure 8. Figure 9 shows how many male and female participants use cloud or do not use it. In Greece, 80% (68 in number) of male participants use cloud and 20% (17 in number) of them do not use it, whereas 88.10% (37 in number) of female use cloud and the rest of them do not use it as shown in figure 8.

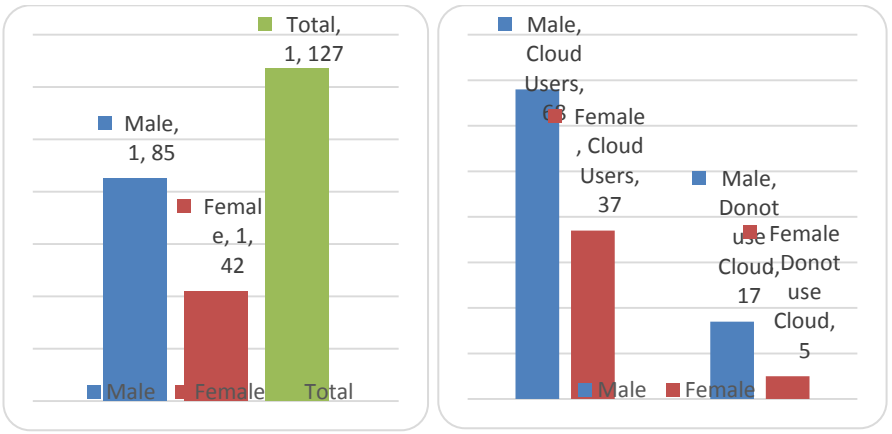

Figure 8 & Figure 9: Categorization of data collected in Greece

Figure 10 and figure 11 present the data collected in Nepal. A total of 31 participants gave the available data. The data commented here were collected from a set consisting of 26 male participants and 5 female participants. Among male participants 65.38% (17 in number) use cloud and 34.62% (9 in number) do not use cloud, whereas 40% (2 in number) of female participants use cloud and the rest of 60% (3 in number) do not use it, as the data illustration shows in figure 11.

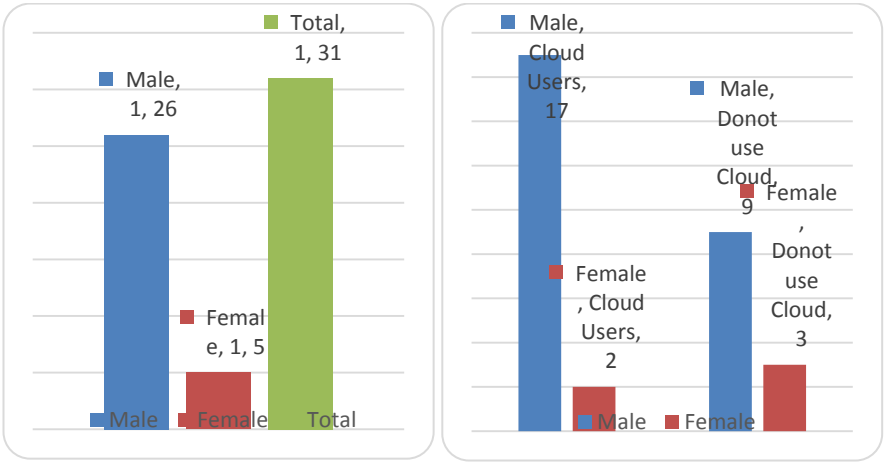

Figure 10 & Figure 11: categorization of data collected in Nepal

Similarly, figure 12 and figure 13 present the data collected in the UK. The data collected in UK was given by 26 valid questionnaire respondents, comprising 20 male and 6 female participants, as shown in figure 12. Among the male participants, only 85% (17 in number) use cloud and the rest 15% (3 in number) do not use it. A notable 100% (6 in number) of the female participants use cloud.

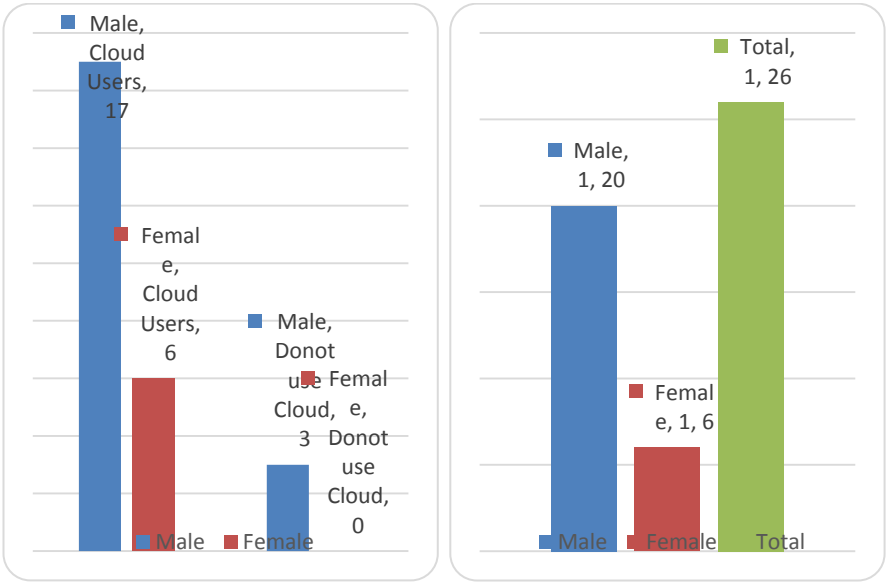

Figure 12 & Figure 13: categorization of data collected in UK

3.1 Comparison of Male/Female Cloud Users Among Five Countries

As shown next, in figure 14, the male cloud users are more than the female cloud users in China and Nepal (Asian countries), whereas female cloud users are more than male cloud users in Finland, Greece and the UK (European countries). Notably, males who do not use cloud services are more than the percentage of the females (not using cloud) in Greece, whereas the opposite is true for other countries. For instance, the females who do not use cloud services are more than males (not using cloud) in China and Nepal. It is also noticeable that according to our sample all females use cloud technology and services in Greece and the UK.

The survey results also show that there are less IT female students in China and only one woman used cloud services. From a gender perspective, China has the lowest ratio comparing to the other four countries. Although the less women IT student phenomena are not only limited to Chinese students, additional recent research studies [9, 11] acknowledge different reasons. For instance, according to Sheng et al. [12] men are more interested in technology than women and fewer

women have technical backgrounds [12, 13]. Other researchers [9, 11, 14] suggest to relate to the phenomenon differently due to the impact of females' personalities, meaning that it is important to also consider feelings such as anxiety, fear, worry, frustration, anger, envy, guilt, loneliness, jealousy …

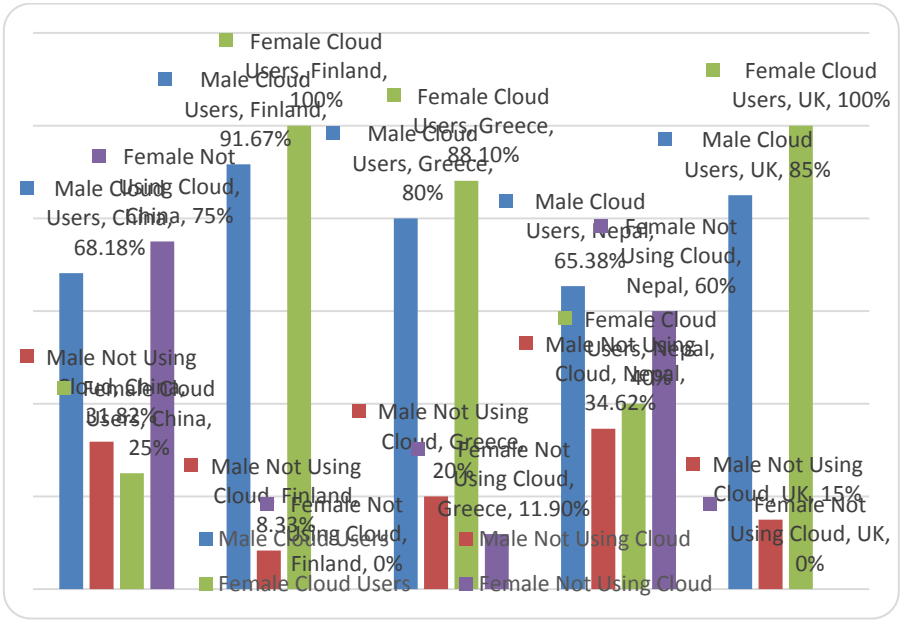

Figure 14: Comparison of cloud users and non-users in five countries

There appear to be different reasons for not using cloud. We specified questions about this aspect in the questionnaire used. Some of these collected reasons for not using cloud in Finland, Greece, Nepal and the UK are plotted in figure 15: Thus, the answer '*I never needed*' is the most common reason for not using cloud with a 50% percentage, whereas the answer '*I don't trust*' is the second most common reason. Similarly, other reasons include '*I don't know how to use them*', '*no access*', '*I never heard*' and *other reasons.*

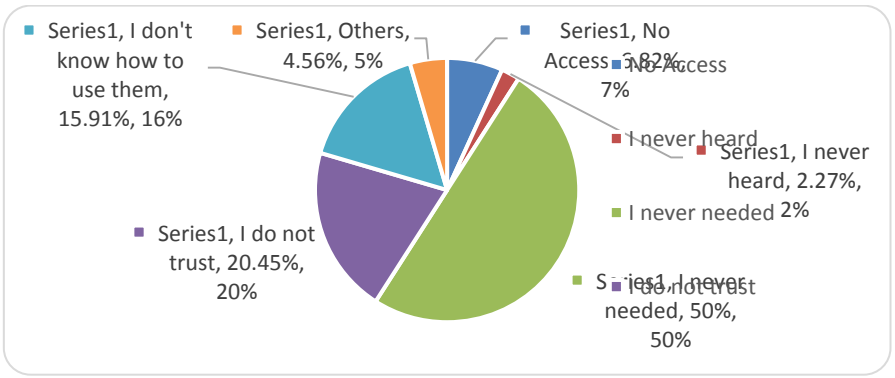

Figure 15: Reasons for not using cloud technology

These reasons have also been categorised based on the countries of the data samples as shown in figure 16.

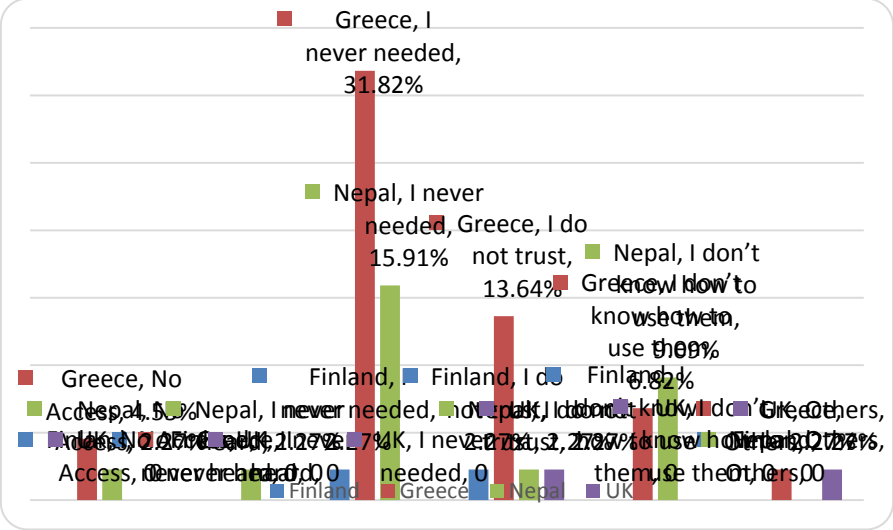

Figure 16: Categorization of reasons by country

'Not having access' is one of the popular reasons for not using cloud in Greece and Nepal. 'Never heard' about cloud is another reason for not using cloud in Nepal. 'No need' to use cloud is another reason in Finland, Greece and Nepal. The later has the highest percentage in Greece, where 31.82% of participants selected this reason for not using cloud services. 'Not trusting' cloud services is another reason that is mentioned in all countries. Last, 'not having knowledge' of using cloud technology is another reason that is apparent in Greece and Nepal.

3.2 Clustering

In order to view the similarities and differences between different countries, we performed K-means clustering taking the numbers of total participants, male participants, female participants, male and female cloud users and numbers of male and female not using cloud in all five countries. We performed clustering for several cycles. When we performed clustering for two clusters, we got one cluster containing only Greece and another cluster containing China, Finland, Nepal and the UK as shown in figure 17. In the second cluster, the distances between those four countries were quite different. The reason behind this distribution (Greece being in a separate cluster) is most probably the difference in the number of participants as Greece has much larger number of participants than other countries.

Future research plans might contain different clusters for analysis and comparison, since there will be more available data from more countries. A comparison, for example, according to Hofstede's index of cultural awareness [5, 6, 7], between collectivist and masculine values countries (Greece, Nepal, China) v individualist and feminine (UK, Finland) cultures countries could be possible.

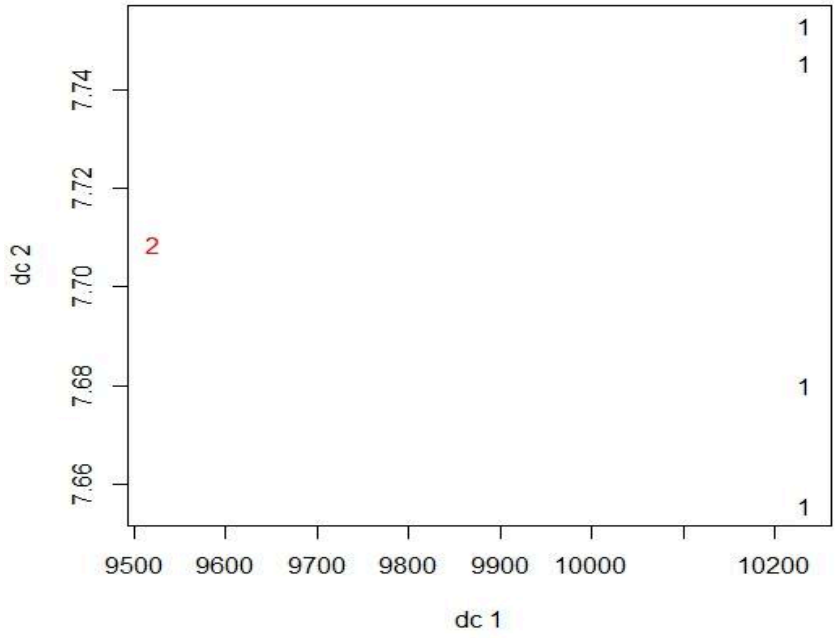

Figure 17: Clusters plot

4. Conclusions, Limitations and Future Research

To carry out this research, we designed a survey using a standard questionnaire. No matter the time and resources limitations, the researchers were able to update the questionnaire on time, according to the discussions and brainstorming findings, and managed to contact the students of the aforementioned and other countries. A pilot questionnaire testing [9] was necessary to enrich the questionnaire with more questions and also made considerable changes in the format and structure of the initial questionnaire.

The participants were BSc and MSc level students majoring in computer science and related disciplines from five countries, of which two are developing countries (i.e. Nepal, China) and the remainder are developed countries (i.e. Finland, Greece,

the UK). The countries that are considered here first are just by chance and because of convenience, since the first data arrived from these countries. However, our research team has dealt with cultural issues and software quality management systems realisation in some of these countries, Greece, Finland and the UK in particular (see e.g. [7, 8, 15]). Notably, it is rather exciting for some researchers to come back to certain research issues and measure change/stability attitudes, if any, in given socio-cultural and geo-physical environments and observe their influence in formal and informal education for future IT professionals.

The authors are currently extending this study to capture a wider international context and cloud services users' needs. Notwithstanding, larger sample sizes are obviously needed to capture the future IT professionals' role, knowledge, skills and digital competencies worldwide. More data in the future will allow to compare and contrast these findings, considering the dimensions of national culture according to Hofstede's research findings [5, 6]. In particular, we plan to consider the following: femininity/masculinity, power distance, collectivism/individualism, and time orientation. A future research question on the rise for future research is: What is the influence of national culture in the use and quality deployment of cloud-based services?

The authors further consider to illustrate the research findings by proceeding to a comparative analysis considering different perspectives such as: gender, education background, national culture (values and culture), and cloud technology relevant knowledge, e.g. computational modelling for trust assumptions and cryptography-based cloud security [16, 17, 18]. The later are important knowledge for prospective IT professionals because this type of knowledge could, in turn, assist in increasing trust in interaction by providing correct data encryption/decryption in cloud services' use.

In order to have a successful realisation of the above plans a deeper in gender perspective and national culture approach are of paramount importance. These preliminary research outcomes together with the earlier surveys' results [7, 9, 11] reveal attention-grabbing information for future male/female IT professionals' skills, knowledge, and competencies in a given societal and geographical domain. Cultural awareness and suitable socio-technical education curricula can lead to IT professionalism and professional success in IT advising and consultancy suggestions. The research findings from an international study on cyber-security should comprise a body of minimum and realistic knowledge for the IT professional community. This is worthy of note when designing curricula of cyber-security technology by accommodating practical and accessible solutions for developing and enhancing the IT professionals' role.

5. References

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